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# INTENSITY OF PREPLANTING SITE PREPARATION REQUIRED FOR FLORIDA'S SANDHILLS

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Two million acres of scrub oak-wiregrass sandhills in west Florida are not producing cash incomes for their owners. However, on a few small sandhill areas planted slash pines (Pinus elliottii Engelm.) and naturally seeded longleaf pines (P. palustris Mill.) have survived and are growing into well-stocked stands. Without exception, these small stands originated on old fields or other cleared sites where the pines did not have to compete with scrub oaks and wiregrass for water and nutrients. All attempts to re-establish pine on this excessively drained soil, without fairly complete site preparation, have been unsuccessful.

Studies of sandhill planting site preparation requirements were started in 1952 on the newly established Chipola Experimental Forest, located in west Florida about halfway between Marianna and Panama City. The research summarized in this paper was concerned essentially with the intensity, rather than the method, of preparation necessary for good survival and growth of planted pines. The results of investigations directly concerned with methods of site preparation are reported elsewhere (2, 6)1/.

## THE PROBLEM

The virgin longleaf pine forests of west Florida were rather open woodlands--scattered pine trees interspersed with scrub oaks and wiregrass (2). Longleaf reproduction and advance growth were scant. In the vicinity of the Chipola Experimental Forest, logging was started about 1900 and has continued wherever merchantable timber remains. The pattern of timber removal has been essentially the same over the entire region, with each successive logging taking smaller and smaller residual trees. Only isolated patches of old-growth remain today, most of them being

1/ Underscored numbers in parentheses refer to Literature Cited, p. 12.

in the protected Eglin Air Force Reservation, on what was formerly the Choctawhatchee National Forest. Over most of the sandhills no pine is left except scattered, individual longleaf trees--either stunted, flat-topped residuals or second-growth trees.

The vegetative cover which has developed in response to removal of the longleaf pine and the frequent grass fires is characterized by dense stands of turkey oak (Quercus laevis Walt.), bluejack oak (Q. incana Bartr.), and wiregrass (Aristida stricta Michx.). Some areas have from 2,000 to 5,000 individual scrub oak stems per acre. Locally, other species may be important, such as persimmon (Diospyros virginiana L.) and dwarf post oak (Q. stellata var. margaretta (Ashe) Sarg.). In very limited areas, mainly along the coast, sand pine (P. clausa (Chapm.) Vasey) is abundant.

The topography of the sandhills and the parent material of their soils were formed during the most recent glacial (Pleistocene) period. As the northern glaciers increased in size, the oceans crept back from the land; the sandhills of the lower Coastal Plain are the bars, spits, dunes, and other high places left exposed around the shores of the receding ocean. Thus the soils (predominantly of the Lakeland series, deep phase) are extremely sandy.

The climate is generally mild, with extremes of temperature rarely over 100° F. or below 20° F. The annual average rainfall is nearly 60 inches, with a range of about 40 to 80 inches. The monthly distribution is fairly uniform, varying from about 2.0 to 3.0 inches in October and November to about 7.0 to 8.0 inches in July and August. The moisture-retention capacity of the soils is so poor, however, that two weeks without rainfall during late spring and summer can result in drouth.

Vegetation and site factors on the Experimental Forest are very similar to those of large areas in west Florida. Therefore, this research should be applicable to large areas of west Florida and other parts of the southern Coastal Plain where turkey oak and wiregrass are dominant on excessively drained deep sands.

## METHODS

In 1952, seven methods of site preparation were tested. These methods, designed to produce different intensities of site preparation, were repeated in another test in 1953. The treatments were:

Bulldozing.--All vegetation and several inches of topsoil were windrowed by a bulldozer. Plots were then either scraped and leveled with a road grader or disk-harrowed with a wheel tractor and harrow. For three growing seasons after pines were planted, oak sprouts were hand-grubbed at least once each season.

Furrowing.--A Mathis-type fireplow was used to make open furrows 4 to 5 inches deep and 4 feet wide, with 2 feet of "spoil" on either side. Furrow centers were approximately 8 feet apart.

Chopping and burning.--Plots were prepared with one trip of a single-drum chopper, weighing approximately 1-1/2 tons, pulled by a bulldozer. The bulldozer knocked down all trees. The chopper cut limbs and twigs less than one inch in diameter, leaving boles and larger limbs uncut. Wiregrass was only slightly disturbed. About two months after chopping, in October, the vegetation was burned with a hot headfire.

Burning.--Plots were burned with a hot headfire in October.

Harrowing.--A heavy-duty bush-and-bog disk harrow was used to prepare the entire plot area. The harrow was 8 feet wide and had six 16-inch serrated disks, set to throw out.

Chemical control of oaks.--All woody stems were treated with foliage sprays (sprouts) or basal sprays of 2,4,5-T. Some larger trees survived, but were killed with Ammate in cups.

No treatment.--This was the check.

All site preparation was done in summer and early fall. Test seedlings were hand-planted the following December and January. On the furrowed plots, seedlings were set in the furrow bottoms.

A randomized block design with four blocks was chosen. Each block contained one large plot (200 by 248 feet) of each site-preparation treatment. These treatment plots were split and planted with pine seedlings for species comparisons. Slash and longleaf pines were planted on the plots prepared in both 1952 and 1953. Sand pine was planted only in 1953. Two 25-tree plantings of each species were established on each major plot of the 1952 treatments; 49-tree plantings of each species were established in the 1953 treatments.

Slash pine gave the best survival of the species tested, regardless of treatment. Average survivals for all site treatments at the end of the first growing season after planting were:

| Pine species | 1952 treatments (Percent) | 1953 treatments (Percent) |
|---|---|---|
| Slash | 54 | 79 |
| Longleaf | 23 | 42 |
| Sand | ... | 42 |

Because of its much better survival, slash pine alone was used to evaluate the site preparation methods.

## SLASH PINE SURVIVAL AND GROWTH

Plots cleared by bulldozing had the highest survivals at the end of the first growing season and the least mortality thereafter (fig. 1). The complete removal of all scrub oaks and wiregrass enabled the planted pines to make optimum use of available moisture and nutrients. Under all other treatments clearing was incomplete and native vegetation recovered quickly and competed in various degrees for soil moisture. This competition was expressed by the progressive mortality of the pines.

The futility of destroying only the scrub oaks and leaving wiregrass was clearly demonstrated. When oaks alone were killed, wiregrass multiplied and produced a level of competition at least equivalent to that existing before the treatment.

Slash pine survival percentages at the end of the first growing season are tabulated below:

| Site treatment | 1952 tests | 1953 tests |
|---|---|---|
| Bulldozing | 94 | 86 |
| Furrowing | 66 | 90 |
| Chopping and burning | 54 | 76 |
| Burning | 52 | 76 |
| Harrowing | 45 | 78 |
| Chemical control of oaks; wiregrass left | 38 | 69 |
| No treatment | 34 | 77 |

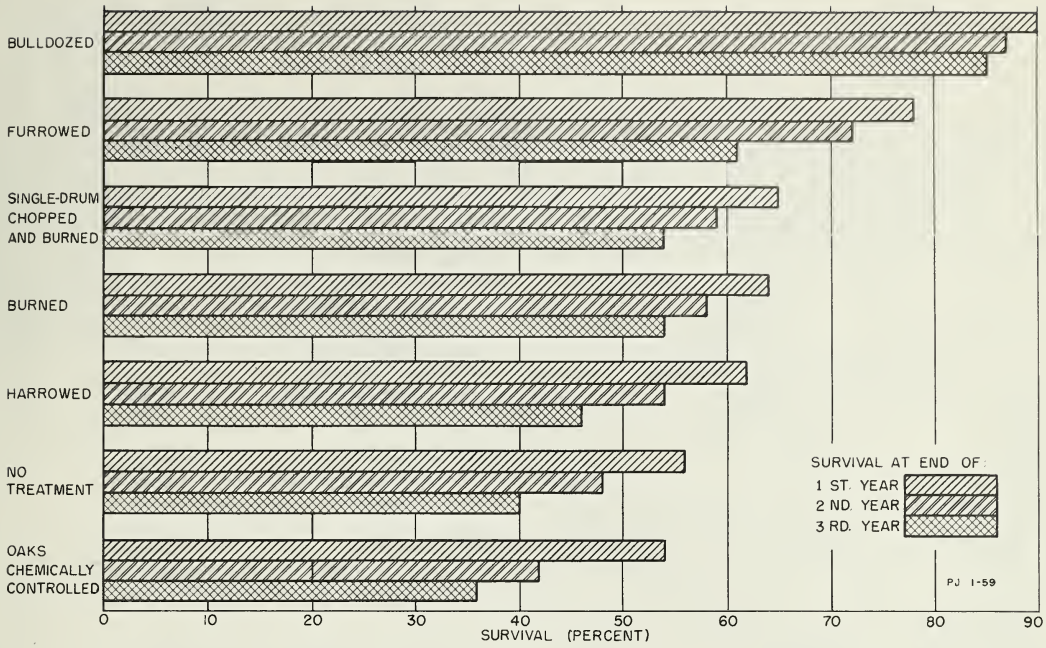


Figure 1.--*Slash pine survivals by site preparation method. Combined data from 1952 and 1953 tests.*

Figure 2.--*Longleaf pine seedling approximately five months after being planted on bulldozed plot. Oak sprouts are almost totally absent and forbs and grasses show extremely poor development.*

Figure 3.--*Furrowed plot (above) and harrowed plot (below), both about 5 months after being planted to pine. The undisturbed native vegetation between the furrows is invading the bared strips. Harrowing left much of the wiregrass and was followed by vigorous sprouting of the oaks.*

Except on the bulldozed plots, pine survival was distinctly higher in the 1953 tests, probably because of a more uniform distribution of rainfall during the spring. Only bulldozing produced high survivals in both years, regardless of weather.

Thus, for first-year survival alone, the degree of site preparation may not be critical if rainfall and soil moisture are adequate. However, later results have shown that pine growth is less and mortality is progressively higher on incompletely prepared sites (fig. 1).

Seedling height growth further confirmed the superiority of bulldozing over less complete methods of site preparation. At the end of the third growing season, average slash pine heights for both tests were as follows:

| Treatments | 1952 tests (Feet) | 1953 tests (Feet) | Average (Feet) |
|---|---|---|---|
| Bulldozing | 2.0 | 1.4 | 1.7 |
| Chemical control of oaks | 1.3 | 1.6 | 1.4 |
| Chopping and burning | 1.5 | 1.3 | 1.4 |
| Burning | 1.3 | 1.3 | 1.3 |
| Furrowing | 1.0 | 1.4 | 1.2 |
| Harrowing | 1.1 | 1.4 | 1.2 |
| No treatment | 1.2 | 1.2 | 1.2 |

As with survivals, growth differences between treatments from tests established in 1952 were greater than from tests established in 1953, with its more favorable rainfall. Bulldozed plots produced the most nearly acceptable average height growth in both tests, but even the best height growth was unsatisfactory. Later studies (2, 6) have shown that substantially better growth can be obtained when planting sites are cleared with either a rootrake-scalper or a tandem-drum brush chopper. These machines, while destroying all of the wiregrass and scrub oaks, leave part or all of the topsoil on the site. The bulldozer removes all of it to a windrow.

Figure 4.--*Plot above was chopped with a single-drum brush chopper and then burned. Plot below was burned only. Both areas are shown about 5 months after planting. Although both treatments killed oak stems, sprouting was vigorous and the wiregrass was not seriously disturbed.*

## SOIL MOISTURE RELATIONSHIPS

Soil moisture relationships were studied in an attempt to learn the factors most limiting to pine survival. Two methods were used to compare treatments: the relative field moisture content and the number of drouth days over an extended period of time.

The relative field moisture content during rainless periods yielded an index to site favorability. On May 18, 1954, 14 days after the last rain, soil samples were taken for moisture determination from all plots installed two years previously.

The samples were quickly placed in soil cans with tight lids, taken to the laboratory, weighed, oven-dried at 105° C. to constant weight, and reweighed. Moisture percentages representing the 3- to 6- and 6- to 9-inch soil horizons were averaged.

The moisture content of these layers of the bulldozed plot was found to be ample for survival and growth. Soil moisture in all other plots was either within or near the wilting range of 1.5 to 1.9 percent (table 1).

Table 1.--Soil moisture (3- to 9-inch soil layer) after 14 rainless days in the second summer following site preparation, and slash pine survival two years after planting

| Treatment | Soil moisture | | Survival | |
|---|---|---|---|---|
| | Percent | Rank | Percent | Rank |
| Bulldozing | 4.16 | 1 | 87 | 1 |
| Furrowing | 2.08 | 2 | 72 | 2 |
| Chopping and burning | 1.73 | 6 | 59 | 3 |
| Burning | 1.57 | 7 | 58 | 4 |
| Harrowing | 1.98 | 3 | 54 | 5 |
| No treatment | 1.92 | 4 | 48 | 6 |
| Chemical control of oaks | 1.81 | 5 | 42 | 7 |

Survival on both burning treatments was proportionately higher than would be expected from the relative field moisture content. The minerals released by burning may have stimulated root growth of planted pines and permitted more complete utilization of soil moisture than was possible on the other unburned

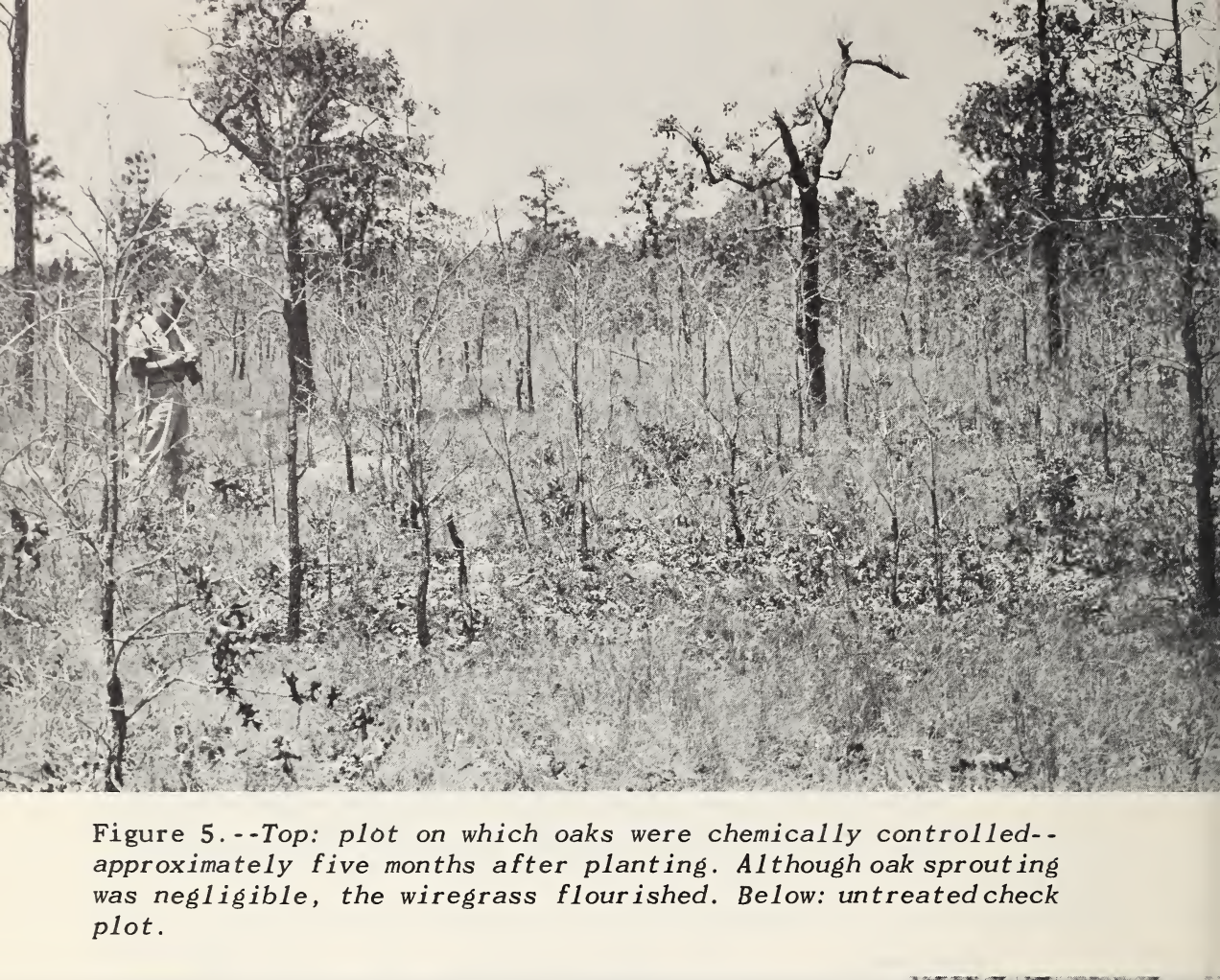

Figure 5.--*Top: plot on which oaks were chemically controlled--approximately five months after planting. Although oak sprouting was negligible, the wiregrass flourished. Below: untreated check plot.*

plots. The possible effects of fire in increasing fertility and decreasing soil moisture also have been recognized by other investigators (4, 5). Fire may be especially valuable in managing sandhills soils, which are inherently low in fertility.

To obtain information on drouth days (table 2) stacks of Colman soil-moisture units were installed at depths of 1.5, 4.5, 7.5, and 10.5 inches in two replications each of the bulldozed, furrowed, chemically controlled, and check plots. Moisture and temperature determinations were made with all units three times a week for two years (1). Data from replicated treatments were averaged. Field experience indicated that 2.0 percent is the approximate limit to which soil moisture can fall and still maintain vital plant processes for an extended period in the soils of the study area.

Table 2.--Drouth days from May 1 to August 31, 1954 and 1955, and survival of slash pine after 2 years

| Site treatment | Proportion of drouth days, May 1 to August 31 1/ | | | | Pine survival |
|---|---|---|---|---|---|
| | 0- to 3-in. depth | 3- to 6-in. depth | 6- to 9-in. depth | 9- to 12-in. depth | |
| | Percent | | | | |
| Bulldozing | 38 | 1 | 4 | 0 | 87 |
| Furrowing | 39 | 9 | 18 | 8 | 72 |
| No treatment | 32 | 21 | 21 | 25 | 47 |
| Chemical control of oaks | 42 | 26 | 24 | 23 | 42 |

1/ Percentages based on 119 sampling dates. In this study a drouth day was defined as a 24-hour period during which the soil moisture was in the wilting range.

As table 2 shows, pine survival was distinctly higher on the sites with the fewest drouth days (the 0- to 3-inch depth excepted). The check plot, with totally undisturbed soil, had fewer drouth days in the 0- to 3-inch soil layer than any other treatment. At lower depths, however, there were fewer drouth days in both the bulldozed and the furrowed plots. Shading by the foliage of oaks seems to conserve soil moisture at shallow depths.

## SUMMARY AND CONCLUSIONS

During 1952 and 1953, seven degrees of site preparation were tested on deep sands at the Chipola Experimental Forest in west Florida. The treatments were evaluated by comparing survival and height growth of planted slash pines through the first three growing seasons after planting.

Complete removal of competing vegetation was found necessary for consistently satisfactory survivals. The principal limit to survival is soil moisture, which quickly becomes critical unless rains are frequent. After 14 rainless days, soil moisture was well above the wilting range only on the bulldozed plots. These same plots, during two consecutive growing seasons, also had the least number of drouth days in the 3- to 12-inch soil layer.

Height growth was unsatisfactory on all plots, though generally better under the bulldozing than under the other treatments. Recent studies have shown, however, that improved preparation techniques which destroy the wiregrass and scrub oaks, but leave the topsoil on the site, will yield acceptable growth.

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